

# REPORT OF TEST

NIST Test # 39075S - Spectral Responsivity

for

Acme Instruments Germanium Photodiode  
Model xx, S/N yyy

Submitted by:

Any Company  
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(See your Purchase Order No. XXXX-XX, dated January 1, 1993)

## 1. Description of Test Material

The test photodiode, Acme Instruments model xx, S/N yyy, consists of a thermoelectrically cooled germanium photodiode mounted in a cylindrical aluminum housing with the output signal available on a BNC connector. The active area of the photodiode is  $\approx x \text{ cm}^2$ .

The test photodiode was measured as supplied by Any Company. The test photodiode was also supplied with an Acme Instruments Thermoelectric Cooler Controller model zz, S/N zzz.

## 2. Description of Test

The test photodiode was compared to two cooled germanium photodiode working standards, Ge #x and Ge #x, using the NIST visible to near Infrared (Vis/NIR) monochromator-based comparator facility [1] from 700 nm to 1800 nm in 5 nm increments. The spectral comparisons between the test photodiode and working standard photodiodes were performed using a double monochromator and a quartz-halogen lamp as the tunable monochromatic source.

The circular exit aperture of the Vis/NIR monochromator was imaged ( $\approx f/9$ ) on the test photodiode, resulting in a beam diameter at the photosensitive area of 1.1 mm. The beam was centered on, and underfilled, the photosensitive area. The photocurrent was measured with the thermoelectric cooler controller set at  $-30^\circ\text{C}$ .

The wavelength scale of the monochromator was calibrated with several laser and emission lines and is accurate to  $\pm 0.1 \text{ nm}$  over the entire spectral range. The bandpass of the monochromator was 4 nm. The short-circuit photocurrent from the test photodiode and each working standard photodiode was measured with a calibrated transimpedance amplifier. The test photodiode and each working standard photodiode were measured with zero bias voltage. Beam power fluctuations were monitored with a beamsplitter and cooled germanium photodiode. The

Laboratory Environment:

Temperature:  $23.x^\circ\text{C} \pm 0.3^\circ\text{C}$

Test Date: December 24, 1997

NIST Test No.: 844/xxxxxx-97/3

A-15

Page 1 of 6

## REPORT OF TEST

NIST Test # 39075S - Spectral Responsivity  
Any Company

Manufacturer: Acme Instruments

Model #: xx

Serial #: yyy

spectral responsivity scale is based on a high accuracy cryogenic radiometer, with a relative expanded uncertainty ( $k = 2$ ) to absolute (SI) units of 0.2 %.

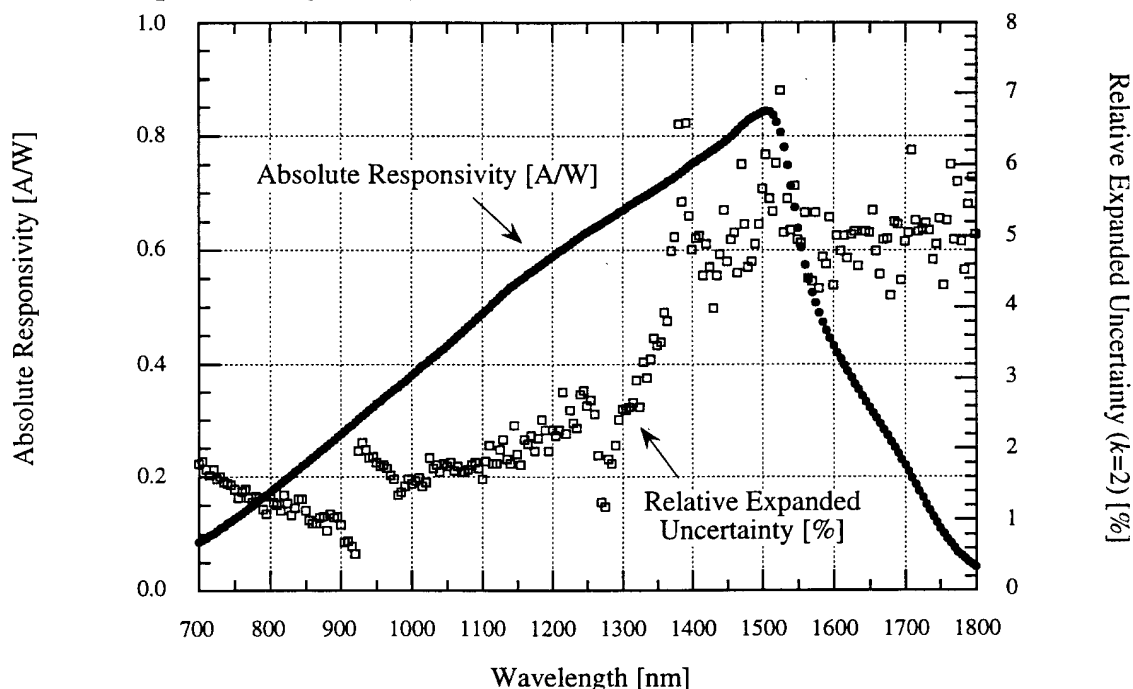
### 3. Results of Test

The absolute spectral responsivity in amperes per watt of the test photodiode is presented as a function of wavelength in table 1 and is plotted in figure 1. The relative expanded uncertainty in the NIST absolute scale is described in Ref. [1]. The relative expanded uncertainty ( $k = 2$ ) presented as a function of wavelength for this measurement is stated relative to absolute (SI) units and is listed in table 1 and plotted in figure 1.

The reported relative expanded uncertainty does not include estimates for several components that are unknown for this test photodiode. The unknown uncertainty components are photodiode responsivity uniformity, polarization sensitivity, linearity, temperature coefficient, and long-term stability. These components could significantly add to the reported uncertainty. Errors larger than the stated uncertainties can occur if the irradiation geometry is significantly different from the test conditions described in section 2.

Figure 1

Absolute Spectral Responsivity of Acme Instruments Photodiode Model xx (S/N yyy)



**REPORT OF TEST**

NIST Test # 39075S - Spectral Responsivity

Any Company

Manufacturer: Acme Instruments

Model #: xx

Serial #: yyy

**Table 1**  
**Absolute Spectral Responsivity of Acme Instruments Model xx (S/N yyy)**

Wavelength [nm]	Absolute Responsivity [A/W]	Relative Expanded Uncertainty ( $k = 2$ ) [%]	Wavelength [nm]	Absolute Responsivity [A/W]	Relative Expanded Uncertainty ( $k = 2$ ) [%]
700	8.55E-2	1.8	900	2.758E-1	0.92
705	8.92E-2	1.8	905	2.810E-1	0.68
710	9.32E-2	1.7	910	2.861E-1	0.70
715	9.72E-2	1.6	915	2.914E-1	0.62
720	1.01E-1	1.7	920	2.968E-1	0.52
725	1.05E-1	1.6	925	3.02E-1	2.0
730	1.09E-1	1.6	930	3.08E-1	2.1
735	1.14E-1	1.5	935	3.13E-1	2.0
740	1.18E-1	1.5	940	3.18E-1	1.9
745	1.22E-1	1.5	945	3.24E-1	1.9
750	1.27E-1	1.4	950	3.29E-1	1.8
755	1.31E-1	1.3	955	3.34E-1	1.7
760	1.36E-1	1.4	960	3.40E-1	1.8
765	1.40E-1	1.4	965	3.45E-1	1.7
770	1.45E-1	1.3	970	3.50E-1	1.6
775	1.50E-1	1.2	975	3.54E-1	1.6
780	1.54E-1	1.3	980	3.59E-1	1.3
785	1.59E-1	1.3	985	3.64E-1	1.4
790	1.64E-1	1.1	990	3.69E-1	1.5
795	1.69E-1	1.1	995	3.75E-1	1.6
800	1.73E-1	1.3	1000	3.81E-1	1.5
805	1.78E-1	1.2	1005	3.86E-1	1.5
810	1.83E-1	1.2	1010	3.92E-1	1.6
815	1.88E-1	1.1	1015	3.97E-1	1.5
820	1.93E-1	1.3	1020	4.02E-1	1.5
825	1.98E-1	1.2	1025	4.07E-1	1.9
830	2.03E-1	1.1	1030	4.12E-1	1.7
835	2.08E-1	1.2	1035	4.16E-1	1.8
840	2.13E-1	1.3	1040	4.21E-1	1.7
845	2.19E-1	1.3	1045	4.27E-1	1.8
850	2.24E-1	1.1	1050	4.32E-1	1.7
855	2.289E-1	0.98	1055	4.38E-1	1.8
860	2.341E-1	0.94	1060	4.43E-1	1.7
865	2.393E-1	0.94	1065	4.49E-1	1.7
870	2.44E-1	1.0	1070	4.55E-1	1.7
875	2.50E-1	1.0	1075	4.60E-1	1.7
880	2.549E-1	0.84	1080	4.66E-1	1.7
885	2.60E-1	1.1	1085	4.71E-1	1.8
890	2.65E-1	1.0	1090	4.77E-1	1.8
895	2.71E-1	1.0	1095	4.82E-1	1.7

Test Date: December 24, 1997

NIST Test No.: 844/xxxxxx-97/3

A-17

Page 3 of 6

**REPORT OF TEST**

NIST Test # 39075S - Spectral Responsivity

Any Company

Manufacturer: Acme Instruments

Model #: xx

Serial #: yyy

**Table 1 (cont.)****Absolute Spectral Responsivity of Acme Instruments Model xx (S/N yyy)**

Wavelength [nm]	Absolute Responsivity [A/W]	Relative Expanded Uncertainty ( $k = 2$ ) [%]	Wavelength [nm]	Absolute Responsivity [A/W]	Relative Expanded Uncertainty ( $k = 2$ ) [%]
1100	4.88E-1	1.6	1300	6.70E-1	2.6
1105	4.94E-1	1.8	1305	6.75E-1	2.5
1110	5.00E-1	2.0	1310	6.79E-1	2.6
1115	5.06E-1	1.8	1315	6.83E-1	2.6
1120	5.12E-1	1.8	1320	6.86E-1	3.0
1125	5.18E-1	2.0	1325	6.90E-1	2.6
1130	5.23E-1	2.1	1330	6.94E-1	3.2
1135	5.29E-1	1.8	1335	6.97E-1	3.0
1140	5.34E-1	1.8	1340	7.01E-1	3.3
1145	5.39E-1	2.3	1345	7.05E-1	3.6
1150	5.44E-1	1.9	1350	7.09E-1	3.5
1155	5.49E-1	1.8	1355	7.12E-1	3.5
1160	5.53E-1	2.1	1360	7.16E-1	3.9
1165	5.58E-1	2.1	1365	7.20E-1	3.8
1170	5.62E-1	2.2	1370	7.24E-1	4.8
1175	5.67E-1	2.0	1375	7.29E-1	5.0
1180	5.71E-1	2.1	1380	7.33E-1	6.6
1185	5.75E-1	2.4	1385	7.38E-1	5.5
1190	5.80E-1	2.3	1390	7.43E-1	6.6
1195	5.84E-1	2.0	1395	7.47E-1	5.3
1200	5.89E-1	2.3	1400	7.52E-1	4.8
1205	5.93E-1	2.2	1405	7.56E-1	5.0
1210	5.98E-1	2.3	1410	7.60E-1	5.0
1215	6.02E-1	2.8	1415	7.64E-1	4.4
1220	6.06E-1	2.2	1420	7.68E-1	4.9
1225	6.10E-1	2.5	1425	7.72E-1	4.6
1230	6.15E-1	2.4	1430	7.76E-1	4.0
1235	6.19E-1	2.3	1435	7.81E-1	4.4
1240	6.23E-1	2.8	1440	7.85E-1	4.7
1245	6.28E-1	2.8	1445	7.90E-1	5.4
1250	6.32E-1	2.6	1450	7.94E-1	4.6
1255	6.36E-1	2.7	1455	8.00E-1	4.9
1260	6.40E-1	2.5	1460	8.05E-1	5.0
1265	6.43E-1	1.9	1465	8.11E-1	4.5
1270	6.47E-1	1.2	1470	8.17E-1	6.0
1275	6.50E-1	1.2	1475	8.23E-1	5.2
1280	6.54E-1	1.8	1480	8.28E-1	4.6
1285	6.58E-1	1.8	1485	8.32E-1	4.6
1290	6.62E-1	2.0	1490	8.36E-1	4.9
1295	6.66E-1	2.4	1495	8.40E-1	5.2

Test Date: December 24, 1997

NIST Test No.: 844/xxxxxx-97/3

A-18

Page 4 of 6

**REPORT OF TEST**

NIST Test # 39075S - Spectral Responsivity

Any Company

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Model #: xx

Serial #: yyy

**Table 1 (cont.)****Absolute Spectral Responsivity of Acme Instruments Model xx (S/N yyy)**

Wavelength [nm]	Absolute Responsivity [A/W]	Relative Expanded Uncertainty ( $k = 2$ ) [%]	Wavelength [nm]	Absolute Responsivity [A/W]	Relative Expanded Uncertainty ( $k = 2$ ) [%]
1500	8.43E-1	5.7	1650	3.23E-1	5.0
1505	8.44E-1	6.1	1655	3.13E-1	5.4
1510	8.42E-1	5.5	1660	3.03E-1	4.8
1515	8.37E-1	5.3	1665	2.93E-1	4.5
1520	8.25E-1	6.0	1670	2.83E-1	4.9
1525	8.06E-1	7.0	1675	2.73E-1	5.0
1530	7.80E-1	5.0	1680	2.62E-1	4.2
1535	7.49E-1	5.5	1685	2.52E-1	5.2
1540	7.13E-1	5.1	1690	2.41E-1	5.2
1545	6.76E-1	5.7	1695	2.31E-1	4.4
1550	6.39E-1	4.9	1700	2.20E-1	4.9
1555	6.05E-1	4.9	1705	2.09E-1	5.0
1560	5.74E-1	5.3	1710	1.98E-1	6.2
1565	5.48E-1	4.4	1715	1.87E-1	5.2
1570	5.26E-1	4.4	1720	1.75E-1	5.1
1575	5.07E-1	5.3	1725	1.64E-1	5.1
1580	4.90E-1	4.3	1730	1.52E-1	5.2
1585	4.74E-1	4.7	1735	1.41E-1	5.1
1590	4.59E-1	4.6	1740	1.30E-1	4.7
1595	4.45E-1	5.3	1745	1.20E-1	4.9
1600	4.32E-1	4.3	1750	1.10E-1	5.2
1605	4.20E-1	5.0	1755	1.00E-1	4.3
1610	4.08E-1	4.8	1760	9.14E-2	5.2
1615	3.97E-1	5.0	1765	8.31E-2	6.0
1620	3.87E-1	4.7	1770	7.55E-2	4.9
1625	3.76E-1	5.0	1775	6.86E-2	5.8
1630	3.65E-1	5.1	1780	6.23E-2	4.9
1635	3.54E-1	4.6	1785	5.66E-2	4.5
1640	3.43E-1	5.1	1790	5.14E-2	5.4
1645	3.33E-1	5.1	1795	4.65E-2	5.8
			1800	4.21E-2	5.0

## REPORT OF TEST

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### 4. General Information

The laboratory temperature is reported for information only. It is not intended that this data be used for corrections to the spectral responsivity data in this report. This report shall not be reproduced, except in full, without the written approval of NIST.

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### Reference:

- [1] T. C. Larason, S. S. Bruce, and A. C. Parr, NIST Measurement Services: Spectroradiometric Detector Measurements: Part I - Ultraviolet Detectors and Part II - Visible to Near-Infrared Detectors, Natl. Inst. Stand. Technol., Spec. Publ. 250-41 (1998).